Architectural Thesis

TEXT

Architecture

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DESIGN FOR AN OFFICE BUILDING

BY

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THESIS

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

RAMON SCHUMACHER

ENTITLED DESIGN FOR AN OFFICE BUILDING

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science in Architecture

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DESIGN FOR

AN OFFICE BUILDING.

In an office building, where each story above the first is used for the same purpose and of equal value, it is a hard problem to make the proper subdivisions of the facade appear natural and not artificial and forced. These conditions have lead architects to express in the elevation the divisions of a column. There must be a base, shaft, and capital, each of which must be made up of a group of stories. The shaft must be the tallest of the three. It should also be the plainest and least varied, because plainness here is needed to give effect to what elaboration there may be elsewhere. Variety here would also lead to confusion. The ornament must be concentrated at the base and capitals. At the base it is effective by being near to the spectator, but care should be taken not to make it so delicate as to take away the appearance of vigor which is so essential to substructure. The ornamentation is effective at the capital by quantity. The shaft is plain and tall and must almost be monotonous, with enrichment of treatment at top and bottom. This is the general scheme of the exterior effect of the most successful office buildings.

There are many other elements besides the exterior design which are necessary in a good solution of the problem. The most important ones are, ease of access, good light, good service, pleasing environment and approaches, the maximum rentable area

consistent with true economy, ease of arrangement to suit tenants, minimum of cost consistent with true economy. The first four are elements of interest to the tenant and the last ones both to the tenant and landlord. The landlord cannot afford to overlook the interests of his tenants, without badly decreasing the value of the rentable space. A relation between the various elements must be established to produce successful results.

Ease of Access:- Almost all access depends upon elevators and they must be placed so as to be reached directly from the street and only a few steps above or below the level of the sidewalk. Very beautiful entrances may be effected by having steps leading up to the door, but the public should not be made to climb many steps. All the elevators should be grouped and so placed that they can all be seen from the middle of the space devoted to them, so that the first car may be taken by any person waiting. This arrangement is even better than having two groups of elevators near the ends of the building. Locate elevators so that they will bring the public within equal distances of the extreme offices, even if those entering the building must walk a distance to get to the elevators. Although it would be saving in travel to have elevators near the entrance, it would take up valuable space and if the tenant wanted an exceptionally large area it would be impossible to arrange for it.

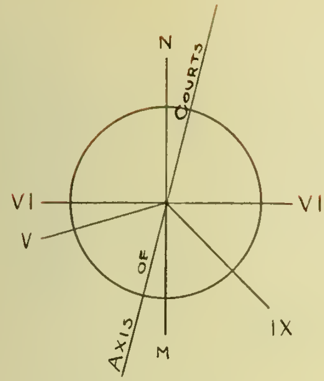
Mr. G. Hill made some observations in twenty of the larger office buildings of New York City as to the number of

stories, number of elevators, intervals between trips, working speed, size of cars, and number of passengers. He tried to produce some law from this data concerning elevators. The class of tenants in the building varies the service greatly and this must be considered in the rules he gives as follows. The car services which gave the best results had a thirty to forty second service so that forty second intervals for each trip should be figured for elevators. Speed was about 400 feet per minute for these good elevators or about 1.87 seconds for each 12 foot 6 inch story. Observation shows that cars travel from 1/3 to 1/8 of the time: this increases with the number of stories served and decreases with the increase in number of offices on each floor. If 150 offices were placed in 8 stories, two cars might carry the passengers but it would take more cars if these offices were only in 2 stories. The time the elevators are not running fixes number, size, and speed.

The influence of stories may be shown by the following data. One building of 240 offices and 7 stories was easily accomodated by two cars while a building of 12 stories and 271 offices had four cars which were always full. A car 5x5 feet gives good satisfaction and at a speed of 450 feet per minute will serve 75 offices well if they are placed on more than 2 and less than 6 stories. Increase the number of cars for more offices or greater travel. For a 25x100 foot building, two cars are needed for all service between four and fifteen stories and for a 50x100 foot

building there should be two cars up to thirteen stories and four cars up to twenty stories. Four cars may provide service enough for any practical height building on such a small lot. For a 100x100 foot lot use four cars up to ten stories, five up to fourteen, and six for all above that number. For buildings in which there are more than twenty offices on a floor there should be added one square foot of area to the average 5x5 foot car for each additional office up to 6x6 feet, beyond which size it is not best to go. In case of larger number of offices per floor, increase number of elevators. Elevators should be made to lift a 2500 pound live load at full speed, should have the entire front readily removable and have the governing device in the corner away from the door, so the rope or wheel will not be in the way when front is open. The controlling device should be a wheel, lever, or switch, the latter being best as it gives better command over the motion of the car. The guides generally should be placed in the corners of the well, to economize in space. Where there is reasonable doubt as to the number of cars to be provided, make provision for the maximum number and install the minimum, leaving the others for later installment when necessary.

Good Light:- This is a very important factor in office building designing, as the rent depends very much upon it. Every office should have sunlight during part of the day. The building and courts should have proper direction of axis. New York lots are laid out at about North 22 1/2 degrees East.



The space between nine and five represents the usual business hours. From six to six represents the length of time sun will be up. The axis should bisect these lines. If courts are made square or nearly so, they will be so proportioned as to throw the shadow of the south wall high up on the north wall and only the top of the court will get direct light. If the court is made oblong and with the long axis north and south, the light at noon will reach to the very bottom, during at least part of the year and go to the maximum distance at all times. If the court is open to the south every office will get direct sunlight every day. Courts should be 6 to 25 feet wide depending on the width of the lot and the size of offices. The ideal location would be onthe northeast or the southwest corner of the street, according to the desire for north or south light.

The amount of window area must be ample. In a unit of 9x15 foot office, with outside light and not on court, about a 4x6 foot window is required with the top of window not more than 1 foot below the ceiling. Square headed windows are much more effective than round headed windows as the volume of light from the top of the window is of much greater lighting value than that coming in near the floor, as it penetrates farther into the room. Under no circumstances should the window sill be nearer than 30 inches from the floor. The light in a room is made much more

effective if there is a certain amount of clear wall space on each side of the window broken only by furniture. The ceiling should be hard finish so that it will reflect light down to the desks. All rooms should be rectangular so that there will be no dark corners or alcoves, and good arrangement of space.

Good Service:- The points which must be considered for good service are toilet arrangements, heating, artificial lighting, ventilation, running water and compressed air.

If toilets are placed on every floor as is best, each toilet should have one water closet for every five offices, one wash basin, supplied with hot and cold water, for every two water closets, but never less than one, and one urinal for each two closets. There should also be a cesspool in the floor with a bell trap and strainer, and draw cocks placed on the supplies for the use of the "scrubs"; or there should be a slop sink placed in a compartment similar to the water closet compartment, with both hot and cold water supplies, and with strainer placed in the waste. If these fixtures are all grouped on one floor their number may be reduced about one half, but in all buildings 50x100 or more, there must be a wash basin and urinal for each floor. On the floor where the toilets for women are placed there should be twice as many water closets as above and if possible, sufficient room for a sofa and a connection for a small gas stove; this room should connect with the janitor's rooms through a lobby.

The fixtures should all drain into a main drainage sys-

tem of wrought iron screw jointed pipe with shouldered fittings, such as are put in by the best plumbers, the pipe being hung perfectly to the beams at the middle story so as to minimize the effect of expansion and contraction. This adds about five percent to the cost of the piping, but is the only safe way plumbing can be done in a large building.

Each office must be provided with a wash basin, which may have cold water alone or both hot and cold. It is a question whether to filter the water or not. If water is first pumped to a tank, it probably will pay to provide for a small amount of alum as a coagulant; then pass the water through a felt filter arranged so as to be washed down by the operation of a lever that works all necessary valves. The water for office buildings, when too high for city pressure, is supplied by extra pressure in the building, either by pressure tanks or by pumping water to a tank on the roof. From this source it is taken by gravity both for drinking and other purposes. The drinking water system includes the compressor which compresses the ammonia; the ammonia in turn cools brine by expanding and the latter is circulated around the compartment to be cooled. Sometimes the ammonia expansion-coil is placed in the drinking water tank. Adrinking fountain is placed on each floor.

Heating and ventilation are closely related and must be considered together. Fireplaces are nuisances and take up valuable room besides being costly. Each office should have a

vent, in connection with which fans could be used. Direct radiation, or at least radiators in the offices must supply the heat; the system might also be direct-indirect.

The building should be lighted primarily by electricity. For emergency it is well to have gas also. At least a single gas jet in each office should be provided, which the "scrub" could use. Each office unit should have at least five outlets; one in the center of the room for a chandelier with its lights controlled by a switch at side of entrance door, and four ceiling lights near the four corners of room. Often these four lights are made brackets but in most cases they prove in the way. The junction box should have its rim flush with the plastering and covered with a brass cover carrying a hard rubber bushing and small male screw. Inside the box are the fuses, on a hard rubber base, and binding posts forthe connection of fixture wires. If city light is used, a meter should be supplied for each office; most large office buildings however, generate their own electricity and in this case the cost of lighting is counted in with the office rent.

Pleasant environment and good approaches are both matters within the control of the owner, subject to the treatment of the artist.

The Maximum of Rentable Area Consistent with true Economy:- This must be considered in two parts; first, as to the plan, and second, as to the way in which it shall be carried into execution.

On each floor there must be the elevator well, halls, stairs, and toilets, each of these require a certain amount of space, and for economy of construction it is desirable that the various floors be made duplicates as far as possible, while for some of the features it is necessary.

Having decided on the size of the elevator car according to the principles before stated, the well should be made one foot larger in each direction than the size of car. It should be placed at or near the center of the building, and of course, plumb and true, and protected from fire by wire glass..

The halls depend, to a large extent, upon the size of the building, but for the usual case of the 25x100 or 50x100 foot building, they must be made as small as consistent with good design. Then we would make the hall on the ground floor as direct as possible from the street to the elevators, and eight feet wide with a space in front of the elevators of the size of the well. For the upper floors, if the space be made four feet wide in front of cars and the halls be made 3 feet 10 inches wide they would be ample. The above width of halls seems very narrow to me and would certainly appear cramped. These dimensions, however are in accordance with the opinion of a well known architect.

It should be kept in mind that the stairs are used only occasionally and are in no way ornamental features that are indispensable, except occasionally when they are meant to lead up to grand offices on the first floor above the street. Gener-

ally the money spent on them could be spent to better advantage in the enrichment of the entrance hall. Leaving out the question of all special cases it may be said that if through the balance of the building the stairs are made three feet wide they will be sufficient for all practical purposes. They should be placed at the end of the hall or at some other out of the way place and be made as plain as possible. Make newels and rails low enough that awkward articles of furniture may be carried up.

The toilets require space as follows for their accomodation: For each water closet a space 2ft. 6 in. wide and 3ft. 10in. deep; for each urinal 2ft. wide and 3ft. deep and for each wash stand 2ft. 6 in. wide and 3ft. 6 in . deep, all as a minimum.

It will be found that there are often tenants that desire an entire floor, and to secure this the elevator service should be placed where it will not interfere with the removal of all of the partitions. The size of the offices must be so arranged that the man who wants a single office will get just sufficient while the man who wants more gets all there can be given on a floor except a minimum space reserved in the least desirable location for toilets and stairs. The subdivision compels a column treatment of the facade, so as to get sufficient light for all of the offices and also indicates a spacing of the columns in the framing, that is the most economical as a general rule.

Such arrangement gives opportunity to make the masonry

piers of sufficient width to satisfy the sense of proportion regardless of their height. The economical depth of an office building must also be taken into account in the planning, for, after a certain point is reached, no more money can be obtained for an office no matter what its depth. There is little data on which to base an opinion, but it is probable that the limit is in the neighbourhood of 16 feet deep in the clear, as beyond this the light is rather bad, and the space loses in value accordingly. This consideration limits the size of a lot since it will be readily seen that there is a point where extra size can only be used for court space or in uselessly increasing the size of the offices

The following seven plans are suggestive of the above principles. In them the toilets are left out, but if accomodation on each floor is desirable, they can readily be arranged for. If they are to be placed on the top floor with the janitor's quarters, they can be easily arranged for there, and with the janitor's quarters will occupy about the space they would occupy alone if scattered through the building.

No drawing is made for a 75x100 foot lot, as this size gives no advantage over the 50x100 foot size, except in giving ample light courts and permitting of a slight enlargement of the offices. These plans are for the average thickness of wall for a steel skeleton and would , of course, require a modification if they were made to conform to the requirements for masonry.

Ease of Re-arrangement:- This is one of the items of cost that

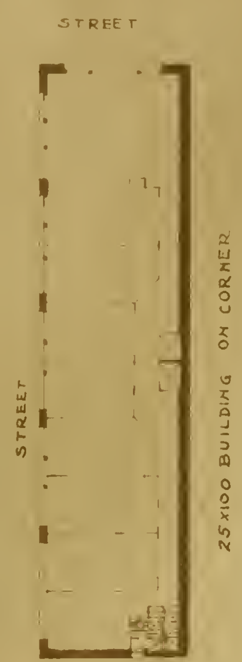


FIG. 1

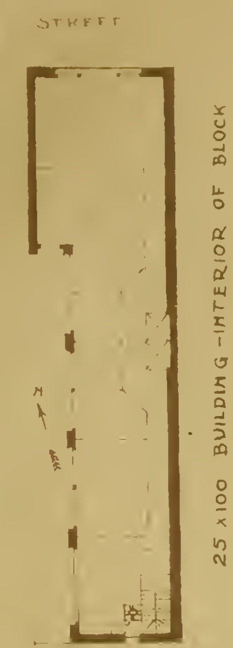


FIG. 2

FIG 3

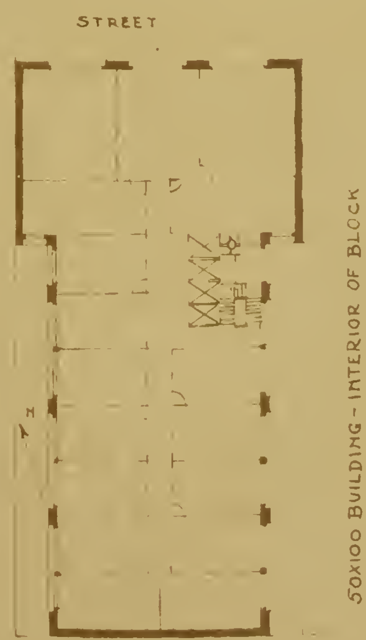
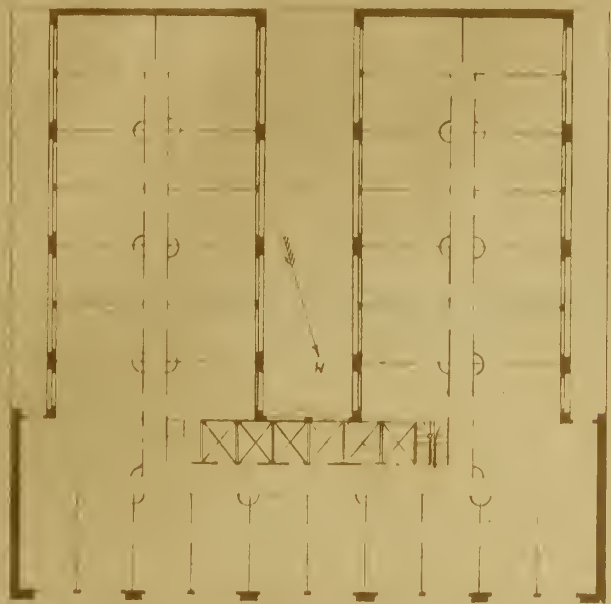


FIG 4

TYPICAL FLOOR PLANS
~ FOR ~
VARIED LOT CONDITIONS



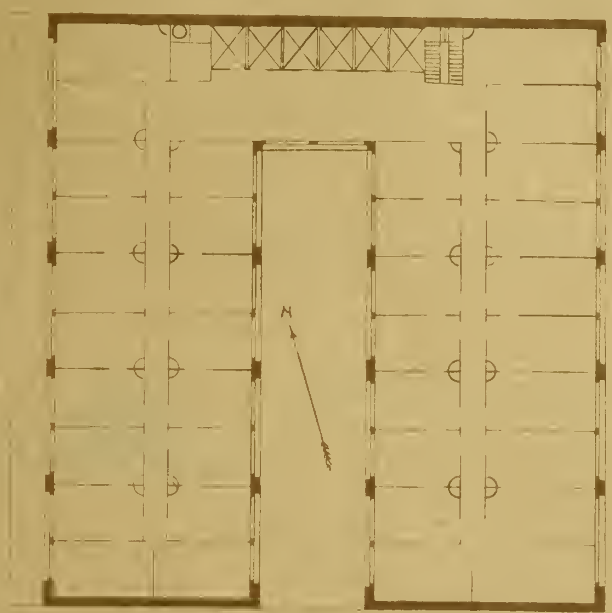
[illegible] BUILDING INSIDE LOT

FIG. 5

[illegible] BUILDING CORNER LOT

FIG. 6

TYPICAL FLOOR PLANS
– FOR –
VARIED LOT CONDITIONS



ALTERNATIVE OF FIG. 5

FIG. 7

TYPICAL FLOOR PLANS
~ FOR ~
VARIED LOT CONDITIONS

rarely enters into the preliminary estimates and is often of serious proportions. If the offices are laid out as advised, much of this trouble willbe avoided and if the partitions are made with corrugated iron lath, plastered on both sides with rock plaster and stiffened by being secured to small I beams, they can be easily changed with the minimum of cost. All of the other constructions will remain undisturbed and ready for any desired number of changes.

Minimum of Cost Consistent with Economy:- There is a limit in height, beyond which it is not safe to go. Every tall building is at times subjected to wind pressures, tending to blow it down. We may say that this is a remote evil, but it is evident that it is a real one. The wind acts against the building in a horizontal direction, so that the building may be considered as in the same condition as a beam fixed at one end, with the other end free and uniformly loaded. In the case of a beam, we would make the depth of the beam such that it would deflect less than the amount necessary to crack plaster. If the beam were supported at both ends, this depth would be one twentieth of the span, and being free, the effect of the load would be increased four times. Finally we know that the length, under these conditions to secure the same deflection, must bear the relation to the width of 0.57 to 1.00. If then, we have an office building 25 feet wide and should make the depth one twentieth of the span, the building would be 500 feet high, and reducing this in the

ratio above given makes the height 285 feet. If we had this height and the wall were pressed against to the predetermined amount, we should have a deflection of 8 to 9 inches, which would throw the center of gravity of the wall beyond the outer edge of the wall, if the building were eight stories high; Keeping this condition in mind, it is probable that the maximum limit beyond which the deflection would be unpleasant, would be from 2 1/2 to 3 inches, and this would give the height from 71 to 95 feet, this according fairly well with the practice. If we work on the assumption that the building is analagous to a beam with one end fixed and the other end free, and make its length one fourth as great as we would if it were supported at both ends, we should have the depth to the length about as 1to 5, or the height would be made 125 feet. This slightly exceeds the upper limit, as found above, and if the building were free standing, there is but little doubt that between four and five times the width would be the safe limit to carry the height, where proper regard was had to the wind bracing. In this connection the limit in the methods of construction imposed by the bracing must be observed even when it increases the cost of the building by the use of the steel type when the height goes beyond the economical limit of this construction.

When the building space rents for $1.50 per square foot, a masonry building pays up to about six stories, and beyond that it is necessary to build in steel. Since it is always desired

to build to make the maximum possible return, we can treat the building as a skeleton type, and enumerate the proper materials to be used to meet the final conditions. Only a first class piece of work should be contemplated, and not such as could be put up by a speculator in order to fill the building with tenants and then sell out to some easily gulled outsider.

Beams and columns must be made strong enough in each story to carry the weight of wall resting upon them without reliance upon walls below them. The exterior walls should be thoroughly anchored to the iron skeleton and not less than twelve inches thick. The rear walls should be made of common brick and courts lined with enamel brick; when facing and body brick are of different sizes, there should be wall ties for every brick as often as courses fall even.

The present flooring system of steel beams in connection with other materials, answers the requirements and is economical. Arrangement should be such that material is used in most economical manner. This will also reduce weight of dead load on joists columns and foundations. Loads to be supported govern flooring system.

Dead load comprises floor beams, arches, floors, partitions, or all materials used in its construction. Live load is the total weight of persons, office furniture, stores and movable goods. In the city of Chicago the law limits the live load to 70 pounds per square foot, and in New York and Boston to 100

pounds per square foot. Birkmire in his book on "Office Buildings" says 100 pounds is too much for proper economy and 70 pounds is high.

Dead Load.

Old Colony Building, Chicago.

Flooring	4#	per sq. ft.
Deadening	18	"
Tile arches	35	"
Iron	10	"
Plastering	5	"
Partitions	18	"
Total	90	"

Offices of Marshall Field Co.

Flooring 7/8 inch maple	4#	/sqft
Deadening	9	"
15 inch tile arch	45	"
Iron	12	"
Plastering	5	"
Partitions 3" Meckolite	20	"
Total	95	"

The above figures refer to office floors. Other calculations are necessary for corridors and toilet rooms, which have mosaic or scagliola floors instead of the edge ground yellow pine. The corridor and toilet roomfloors would average about 125 pounds per square foot.

Plastering should be rock plaster, hard finish, with plaster carried into all joints and reveals, with corners rounded off and a small cove at ceiling say of 6 inch radius.

Trim of white oak, filled, oiled and rubbed to a good finish. Halls should have either a Keene's cement or Mycenian marble wainscoat, with marble base and cement cap. Sometimes the cap is made of rock plaster and base of marble, the space between being covered with an enamel paint.

In designing the machinery hall it is important that the engines, pumps, elevators, switch board, and dynamos should not be restricted to damp or hot places. Generally office buildings have

their own power plants to supply energy for the pumps, dynamos, and elevators and steam for the heating system. The Central National Bank building has about 12 000 square feet devoted to machinery. The best system for heating is the vacuum steam. It is flexible in amount of circulation attained so that the maximum may be applied at one portion of the pipes and a less amount at others, depending upon stormy weather. District-messenger, telegraph and telephone companies' service enters the subcellar, and the wires are connected to the cable wires in the main connecting box by means of numbered connectors, in groups from 1 to 20; one group being provided for each direct cable, and one group for the interconnecting or through cable which connects to the boxes on all floors. If any room in the building needs telephone or telegraph communication, it is very easy to run a wire from the boxes in hallway to the room.

Note.

In my office building design the first floor is occupied by a National Bank. The following pages are devoted to a discussion of banks.

Building	No. of Stories	Ht. from Grade to Cornice	Lot Area	Bld. Area 1st Floor	Average Floor Area	% of Av. Area to Lot
Old Colony	17&A	212'-6"	10115	10115	10274	1.0157
Marquette	16&A	207'-3"	24190	23790	18881	.7805
Champlain	15	188'-8"	7085	7085	6541	.9232
Venetian	13	158'	5718	5718	5718	1.0000
Atwood	10	130'	5048	4967	4775	.9459
Wachusetts	17	205'-7"	6584	6584	6703	1.0337
Kathdin	17	205'-7"	6584	6584	6685	1.0153
Pontiac	14	172'	6700	6700	6942	1:0630
Caxton	12	148'-6"	5343	5343	5498	1.0300
Rookery	11	162'-4"	29759	26584	25783	.8664

Building	Area of Court 1st Floor	Cost	Cost per cu. ft.	Janitor Meter Closets	% to Bldg
Old Colony		$928548.23	42.16¢	1918	.01
Marquette	400	1385058.08	31.04	1390	.004
Champlain	425	552332.18	40.21	1131	.0103
Venetian		444757.00	43.447	220	.0026
Atwood	339	/260000.00	35.	635	.0112
Wachusetts		625613.18	41.007	1258	.0102
Kathdin		601250.79	39.247	1260	.0103
Pontiac		384927.12	29.152	426	.004
Caxton		227200.00	24.858	220	.003
Rookery	3175			2200	.0067

Building	Outside Walls	% to Bldg	Chimney and Pipe Shaft	Toilet Rooms	% to Bldg	Elevators
Old Colony	16371	.0862	1802	1712	.0090	5950
Marquette	24341	.07	1426	2054	.0083	8959
Champlain	9626	.0880	1070	896	.0081	3578
Venetian	6080	.0733	1625	764	.0092	2180
Atwood	4125	.0726	770	844	.0149	1716
Wachusetts	11835	.0960	1904	1020	.0080	3689
Kathdin	11078	.0908	1904	250	.0021	3689
Pontiac	7640	.0720	2206	961	.0090	1960
Caxton	4410	.0606	840	761	.0105	1380
Rookery	19075	.0586	5008	3605	.0111	6052

/ Approximate

Building	% to Bldg	Light Shafts	% to Bldg	Janitor Apartments	Average Court Area
Old Colony	.0312				
Marquette	.026	1064	.0030	[illegible]	5321
Champlain	.0326	196	.0018		573
Venetian	.262				
Atwood	.0302				355
Wachusetts	.300				
Kathdin	.0302				
Pontiac	.0185			632	
Caxton	.0190				
Rookery	.0186				3976

	% of Average Court to Lot	Average Rental Area	% of Rental to Lot	Cubic Contents
Old Colony	.	7475	.7390	2202000
Marquette	.2195	13524	.5586	4397495
Champlain	.0808	4517	.6370	1373612
Venetian		4045	.707	1023670
Atwood	.0604	3333	.660	743800
Wachusetts		4489	.682	1547344
Kathdin		4067	.6177	1531929
Pontiac			.7300	1320396
Caxton		4104	.7681	913965
Rookery	.1336	17846	.590	4712143

	% to Bldg	Machinery	% to Bldg	Stairs	% to Bldg
Old Colony	.0094	8146	.0430	2452	.0140
Marquette	.0182	10799	.0307	4491	.0128
Champlain	.0098	4653	.0425	1601	.0145
Venetian	.0200	2820	.0341	1017	.0123
Atwood	.0136	2920	.0514	1012	.0178
Wachusetts	.0155	3660	.0297	1934	.0157
Kathdin	.0156	4875	.0400	1763	.0145
Pontiac	.0208	3360	.0316	1224	.0115
Caxton	.0115	2520	.0346	1200	.0165
Rookery	.0189	17000	.0522	5399	.0166

Building	Halls	% to Bldg	% to Bldg	Rental Area	% to Bldg
Old Colony	17705	.0932		133353	.7040
Marquette	42375	.1210	.0030	246015	.7030
Champlain	13344	.1220		73426	.6704
Venetian	10509	.1271		57452	.6950
Atwood	6443	.1135		38303	.6748
Wachusetts	16300	.1324		81578	.6622
Kathdin	23998	.1967		77214	.5920
Pontiac	13971	.1316	.0060	73765	.6950
Caxton	8637	.1187		52701	.7256
Rookery	46726	.1435		219731	.6746

Building	Area inside of Building Line	% to Bldg
Old Colony	189409	1.000
Marquette	349865	1.000
Champlain	109521	1.000
Venetian	82667	1.000
Atwood	56768	1.000
Wachusetts	123187	1.000
Kathdin	121981	1.000
Pontiac	106145	1.000
Caxton	72159	1.000
Rookery	325606	1.000

BANKS.

Banks may be divided into the following classes, saving, commercial, trust company, and safe deposit. The proper arrangement and proportional areas to be allowed for the individual departments of each class cannot be fixed. Each bank has its own individuality, and has an arrangement best suited to it and its officers.

Large commercial banks with country affiliations need a small public space in comparison with that allowed for its book-keepers, check department and correspondence clerks. The savings banks, however, need large public space to accomodate the crowds on dividend days.

Upon entering the bank, the officers rooms should be the first to be encountered; they should have good arrangement and good light. In such as savings banks, the officers rooms may be placed more to the rear as the customers need not see them. Where officers are in communication with the public, the departments of the president and cashier should be accesible, others should be more remote but stationed near various departments with more or less communication. The departments are as follows: loans and discounts, credit and correspondence, mail, notes, auditor and passbooks, receiving teller, paying teller, drafts, exchange, collections, checks, vouchers, book-keepers and safe. The tellers may act without frequent instructions, but the loan and discount department must be controlled directly and in charge

of the assistant cashier and near the officer's rooms. The money and the pass book departments are more remote but the latter should be placed near the vault and near the center. The pass book and exchange departments are associated with the cash tellers The note teller is placed near the loan and discount teller. The clerical departments should be placed as follows: near the executive, the credit and correspondence, stenographers' and mail departments, and more remote, the check desks, collection department, voucher clerks and files, stationery stores, telephones,etc. Only very large banks would have all these distinct departments.

In savings banks, the depositors are usually guided by rails, which lead them from the entrance to the receiving teller or to the pass book and signature clerks, and from there, for withdrawals, to the paying teller and the exit by different doors than entrance. The public lobby must be large and if possible so arranged that men and women may be divided into two groups, one on each side of a central tellers department. The horse shoe plan is suitable for this, the middle part of which space is occupied by the bookkeeper. The loan department is practically the offices of the treasurer and president, where sums are borrowed on mortgage.

In trust companies, business is slower and not much public space is necessary. The officers are known by their names and the whole has little of the character of the regular bank. This class of bank has no established type.

The security of banks is accomplished by fire proof and burglar proof appliances, vaults, safes, etc. To provide good supervidion and safety, a bank should have but one entrance. It may be necessary to provide outside access to the basement for the janitor or engineer, but if possible, this should be combined with the main entrance vestibule, or entered by an elevator controllable by one man.

The cash vault should be placed so that the chief teller may supervise it and sometimes the door is even arranged within his caged appartment. The security vault is often placed in the basement. The stairway used by clerks may properly be placed close to a basement vault door, for then it is less apt to be disturbed.

Vaults must be so constructed that they will resist fire and robbery. Care should be taken to make the vault clear of contact with the building on all sides. A space wide enough for passage should be left all around the vault and also a space between top of vault and ceiling of room in which it stands. The vaults should be supported on separate foundations so that in case any steel work of the building bends, the doors will remain true. The best way to provide ventilation is to fit covers in the top of the vault which can be fastened in the same manner as the doors.

There are several methods of construction of vaults. One type is built up of steel plates from 1/2 inch to 1 inch

thick screwed together forming a thickness from 3 to 6 inches. Sheets of steel and chrome steel are alternated in the wall, the latter resist the drill. Sometimes railroad iron is used in vault construction and the head and flange alternately locked. These are bolted together and bedded in Portland cement, the inter stices also being filled. Steel plates are put on the inside and outside to complete the construction. Safe deposit vaults should always have two entrances so as to avoid lockouts, which sometimes occur by the stopping of the time locks. The time lock has been invented for vaults so that those intrusted with the combination will not be forced to reveal it. Two clocks are generally used on each vault or safe so as to guard against one stopping. Secondary combinations are kept by the manufacturers which only operate when the clocks have stopped. Sometimes it is necessary to have the manufacturers send a man with this combination to open the door.